

CLAIMS

What is Claimed is:

1. A method for fabricating a hollow micro-needle array comprising the steps of:

providing a silicon substrate;

depositing a protective layer on said silicon substrate;

defining a plurality of regions for wet etching;

wet etching said silicon substrate forming a plurality of recesses having inclined sidewalls; and

continuing processing said plurality of recesses forming a hollow micro-needle array.

2. A method for fabricating a hollow micro-needle array according to claim 1, wherein said continuing processing step is selected from the group consisting of electroplating, imaging/developing and micro-electrical-mechanical machining.

3. A method for fabricating a hollow micro-needle array according to claim 1 further comprising the step of providing a polymeric substrate instead of the silicon substrate, and forming said plurality of recesses with inclined sidewalls by a laser processing technique.

4. A method for fabricating a hollow micro-needle array according to claim 1 further comprising the step of providing a photoresist material instead of said silicon substrate, and forming said plurality of recesses having inclined sidewalls by imaging and developing.

5. A method for fabricating a hollow micro-needle array according to claim 1, wherein a tip portion of a micro-needle in said hollow micro-needle array is at least partially formed in a tapered shape.

6. A method for fabricating a hollow micro-needle array according to claim 1, wherein said continuing processing step further comprises the sub-steps of:

photolithographically depositing a photoresist material on top of said silicon substrate and forming a plurality of recesses;

plating a metal in said plurality of recesses forming a plurality of metal micro-needles;

removing said photoresist material exposing said plurality of hollow metal micro-needles; and

etching said silicon substrate forming a plurality of hollow metal micro-needles.

7. A method for fabricating a hollow micro-needle array according to claim 6 further comprising the step of:

depositing a starting metal layer on said silicon substrate in said plurality of recesses having inclined sidewalls.

8. A method for fabricating a hollow micro-needle array according to claim 6, wherein said plating step is selected from the group consisting of electroplating, electroless plating evaporation and sputtering.

9. A method for fabricating a hollow micro-needle array according to claim 6, wherein said metal is selected from the group consisting of copper, chromium, nickel, iron, gold, platinum, palladium and their alloys, and stainless steel.

10. A method for fabricating a hollow micro-needle array according to claim 6, wherein said removal step for said photoresist material and said hollowing process of the micro-needle are carried out by a technique selected from the group consisting of laser processing, etching and photolithography.

11. A method for fabricating a hollow micro-needle array according to claim 6 further comprising the step of using said silicon substrate with said metal micro-needle as a mold for fabricating a multiplicity of micro-needles.

12. A method for fabricating a hollow micro-needle array according to claim 11, wherein said multiplicity of micro-needles can be fabricated by micro-injection molding or a micro-thermal compression forming technique.

13. A method for fabricating a hollow micro-needle array comprising the steps of:

providing a silicon substrate;
depositing a protective layer on said silicon substrate;
defining a plurality of wet etch regions;
wet etching the plurality of wet etch regions on said

silicon substrate forming a plurality of recesses each having inclined sidewalls;

depositing sequentially an anti-reflective coating layer and a sacrificial layer on top of said silicon substrate;

depositing a photoresist layer;

imaging said photoresist layer for said micro-needle array;

removing said sacrificial layer obtaining a bottom layer with inclined sidewalls; and

developing said bottom layer forming a micro-needle array.

14. A method for fabricating a hollow micro-needle array according to claim 13 further comprising the step of, after the deposition of said photoresist layer, removing said sacrificial layer and then imaging and developing said bottom layer.

15. A method for fabricating a hollow micro-needle array according to claim 13, wherein said sacrificial layer is a mold release layer.

16. A method for fabricating a hollow micro-needle array according to claim 13 further comprising repeated steps of depositing said photoresist layer and imaging said photoresist layer such that an internal diameter of the flow passage in said micro-needle array is changed for serving as a storage function.

17. A method for fabricating a hollow micro-needle array comprising the steps of:

providing a silicon substrate;

depositing a protective layer on top of said silicon substrate;

defining a plurality of wet etching regions;

wet etching said silicon substrate forming a plurality of recesses each having inclined sidewalls;

depositing a sacrificial layer on top of said silicon substrate;

compression molding by using a material having sufficient plasticity;

removing said sacrificial layer obtaining a bottom layer having inclined sidewalls; and

micro-machining said silicon substrate obtaining a micro-needle array.

18. A method for fabricating a hollow micro-needle array according to claim 17, wherein said sacrificial layer is a mold release layer.

19. A method for fabricating a hollow micro-needle array according to claim 17, wherein said material with sufficient plasticity is selected from the group consisting of hot solid material and hot molding material.

20. A method for fabricating a hollow micro-needle array according to claim 17, wherein said compression molding step of said material with sufficient plasticity is replaced by an injection molding process for said material with sufficient plasticity.

21. A method for fabricating a hollow micro-needle array according to claim 17, wherein said micro-processing step comprises laser processing steps or etching steps.